Vybzing Grenada 2018

Climate SMART Agriculture

Climate Action Today = Food for Tomorrow

Keeley Holder

May 23, 2018

SCIENCE

ONLY explains

what happens in nature

CLIMATE CHANGE &
AGRO-METEOROLOGY

Thought 1
Context
Commands It

Thought 2

Thought 3

Our context...

'Rainfall is King'

'For Agriculture rainfall is king'

Since rainfall is a climate quantity whose amounts, intensity and duration will vary and possibly change...

Vulnerability

Science Supports It

Thought 1
Context
Commands It

Thought 2
Science
Supports It

Thought 3

Our science supports consideration of the issue by suggesting

Significant variability in Caribbean rainfall (seasonal through decadal)

Translates into significant variability in water availability

Variability – 'Irregular short (year to year)'

Variations that interrupt Seasonality

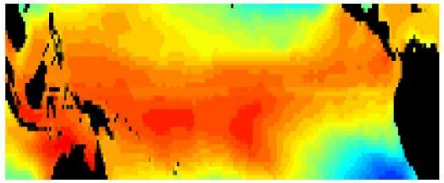
Thought 1
Context
Commands It

Thought 2
Science
Supports It

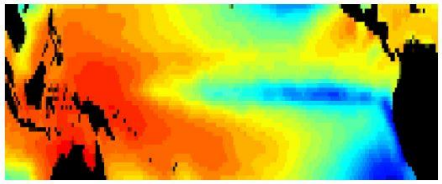
Thought 3

ENSO - El Niño-Southern Oscillation

- Is a global coupled ocean-atmosphere phenomenon.
- **El Niño (La Niña)** is an unusual warming (cooling) of the tropical Pacific Ocean.
- The **Southern Oscillation** is an accompanying fluctuation in the air pressure difference between Tahiti and Darwin, Australia.
- **Prompts changes in weather patterns across the globe.**
- **Occurs irregularly at approximately 3-6 year intervals.**



El Niño



La Niña

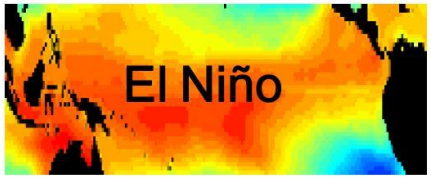
Thought 1
Context
Commands It

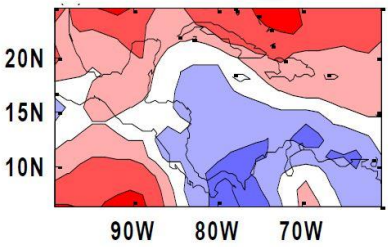
Thought 2
Science
Supports It

Thought 3

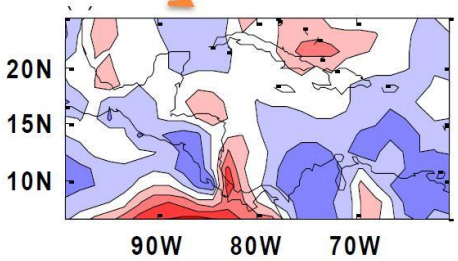
Variability – 'Irregular short (year to year)'

Variations that interrupt Seasonality





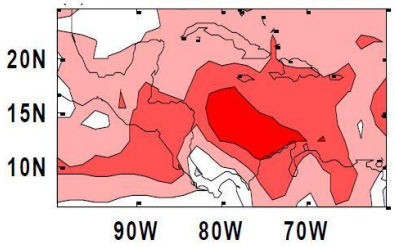
3. Early Wet season drier in most of the Caribbean



1. Dry season drier in south Caribbean

Changes large scale circulations

Warms Caribbean Sea



2. Late wet season drier in most of the Caribbean

Increases shear

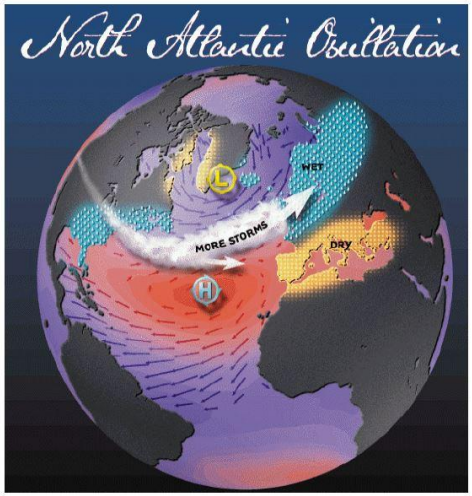
Variability – 'Irregular long (decadal or more) '

NAO

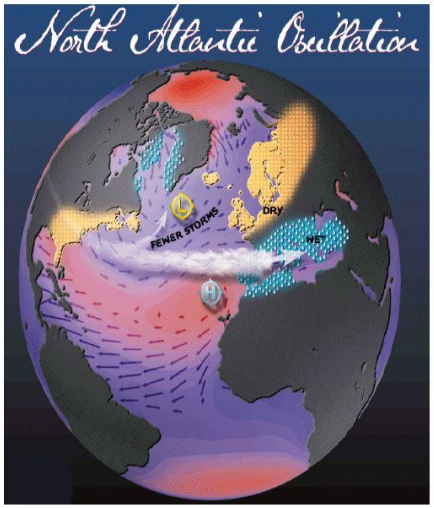
Thought 1
Context
Commands It

Thought 2
Science
Supports It

Thought 3



Positive phase => Drier Caribbean (particularly eastern Caribbean)



Negative phase => Wetter Caribbean (particularly eastern Caribbean)

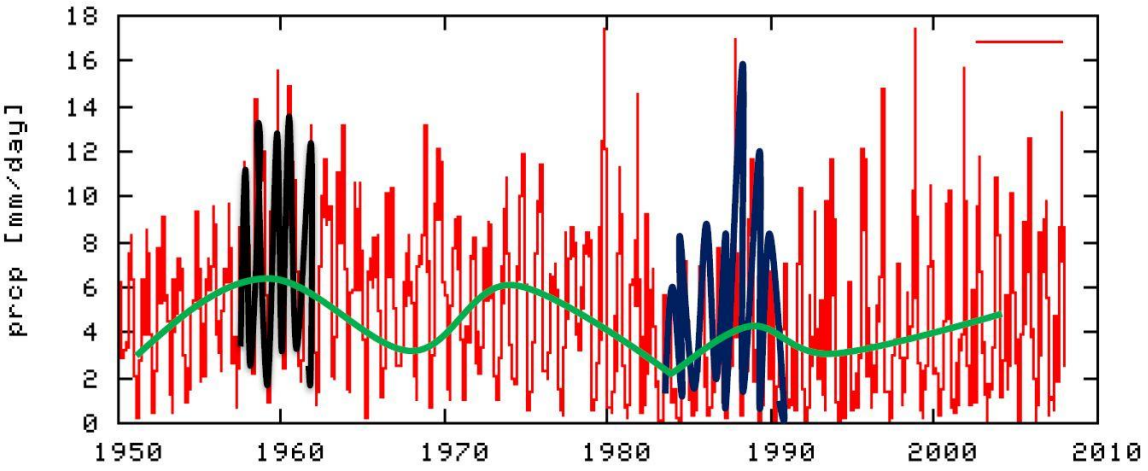
Variability

Thought 1
Context
Commands It

Thought 2
Science
Supports It

Thought 3

Regular **Irregular 'short'** **Irregular 'long'**



Thought 1
Context
Commands It

Thought 2
Science
Supports It

Thought 3
Future
Depends on It

Future Depends on It

Climate Change

If our context commands consideration of the issue

Vulnerability...

Then our science supports consideration of it by suggesting how the vulnerability will play out

Variability...

And our future demands consideration of it as climate change has and will continue to alter rainfall and other parameters (significantly) on long timescales

Viability...

Climate Change

Thought 1
Context
Commands It

Thought 2
Science
Supports It

Thought 3
Future
Depends on It

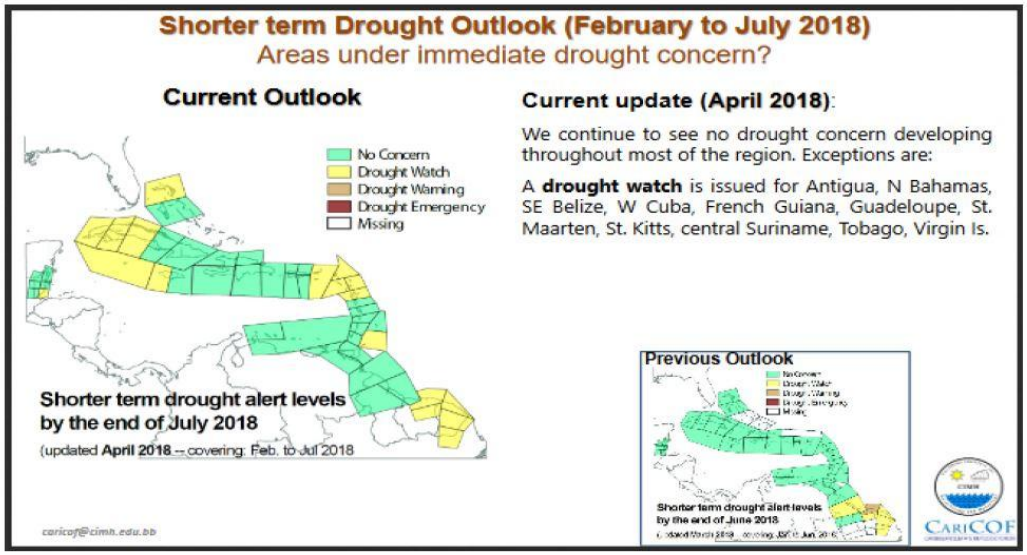
Climate Change Picture

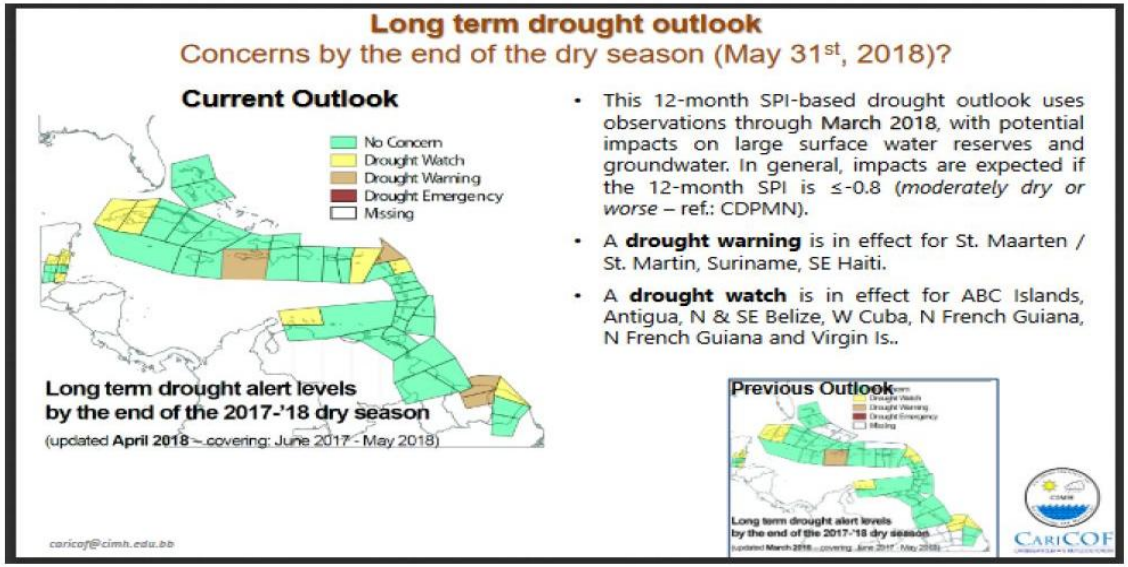
Temperatures	• Increase to end of century • 1-4 degrees • Warmer nights and days
Rainfall	• Variability • More intense storms • Drying by end of century
Sea Level Rise	• Rising sea levels • Erosion, inundation and storm surge • 1 m or 2 m…Hmmm?

http://rcc.cimh.edu.bb/

Drought Outlook for the End of July

CariCOF's Drought Alert Map





AGRICULTURE &
THE ENVIRONMENT

Soil is ‘BLACK’ Gold

FARMERS

GUARDIANS of the Environment

FARMERS

AVENGERS of the Health & Wellness of Nation

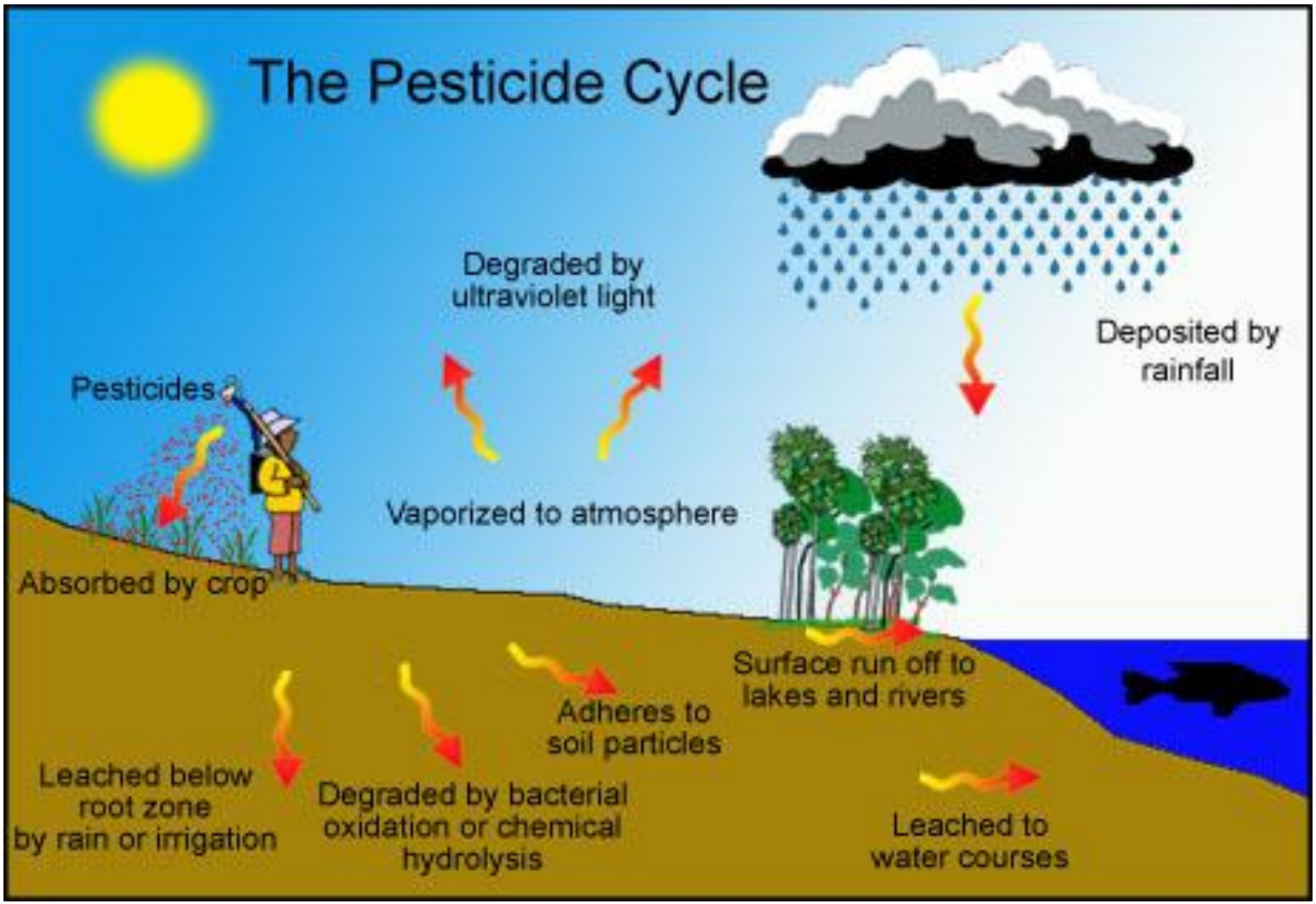
SOIL DEPLETION

1940 vs. 1991

Reduction in average mineral content
of fruits and vegetables between 1940 and 1991

MINERAL	VEGETABLES	FRUITS
Sodium	-49%	-29%
Potassium	-16%	-19%
Magnesium	-24%	-16%
Calcium	-46%	-16%
Iron	-27%	-24%
Copper	-76%	-20%
Zinc	-59%	-27%

PESTICIDE ABUSE




SHARE TO END THE MYTH
Organic
is not pesticide-free.

THE BIG BEEF DEBATE

Grass Fed vs Grain Feed Quality Revealed

Beef's Nutritional Ledger		
	Grain-Fed Beef	**Grass-Fed Beef**
Added Hormones	Usually	No
Fed Antibiotics	Usually	No
Fed Grain	Yes	No
Omega-3 Fatty Acids	0.10	1.22
Omega-6 Fatty Acids	3.10	1.08
CLA	0.21	1.46
Beta Carotene	41.00	87.00
Vitamin E	1.30	5.30
Vitamin A	10.00	52.00
Total Fat	High & Saturated	Perfect Balance

Nature, to be commanded, must be obeyed.

~ Francis Bacon

POWER THOUGHT

FARMING

BIG

Responsibility

CLIMATE SMART AGRICULTURE
IN PRACTICE

CSA OBJECTIVES

- ✓ Sustainably increasing **productivity** & **incomes**
- ✓ Adapting to climate change
- ✓ Reducing greenhouse gas emissions

POWER THOUGHT

THE 'BEST'

There is NO "ONE BEST WAY" to farm.

Its about the "BEST FIT" for your purpose.

CSA

THROUGH PRODUCTIVITY

PRODUCTIVITY

"Productivity growth through research & development in agriculture & food technology have been responsible for the dramatic increase in average yields by improving machinery & equipment and increasing technological efficiencies, such as the use of new fertilizers (organic & inorganic), feeds, seed varieties, automated irrigation management, life cycle analysis and postharvest management."

PRODUCTIVITY

USA: 1950 vs 2000

OUTPUT

- each farmer = 12 times more farm output /hr

COWS

- avg. milk = 5,314 lbs / yr to 18,201 lbs / yr

CORN

- Avg. corn = 39 bushels/acre to 153 bushels /acre

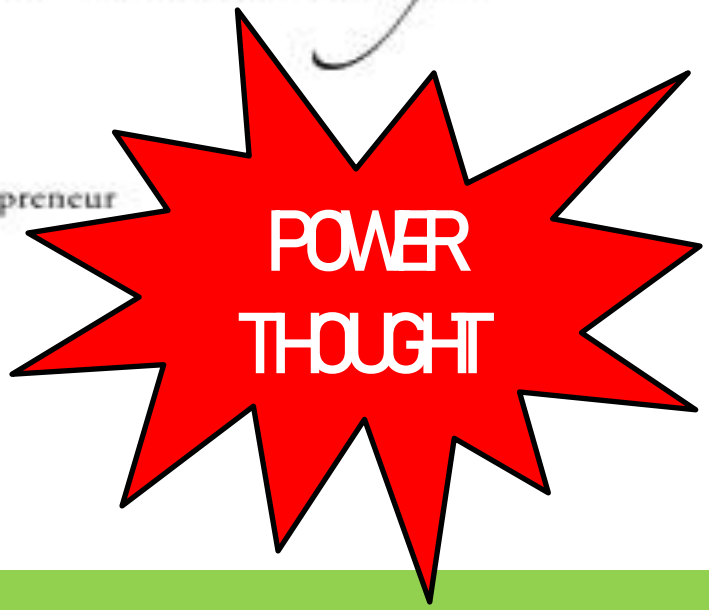
GROWER ATTITUDE

why settle for competence...

GROWER THINKING

"A BUSINESS IS A
repeatable process
THAT MAKES MONEY.
Everything else is a hobby."

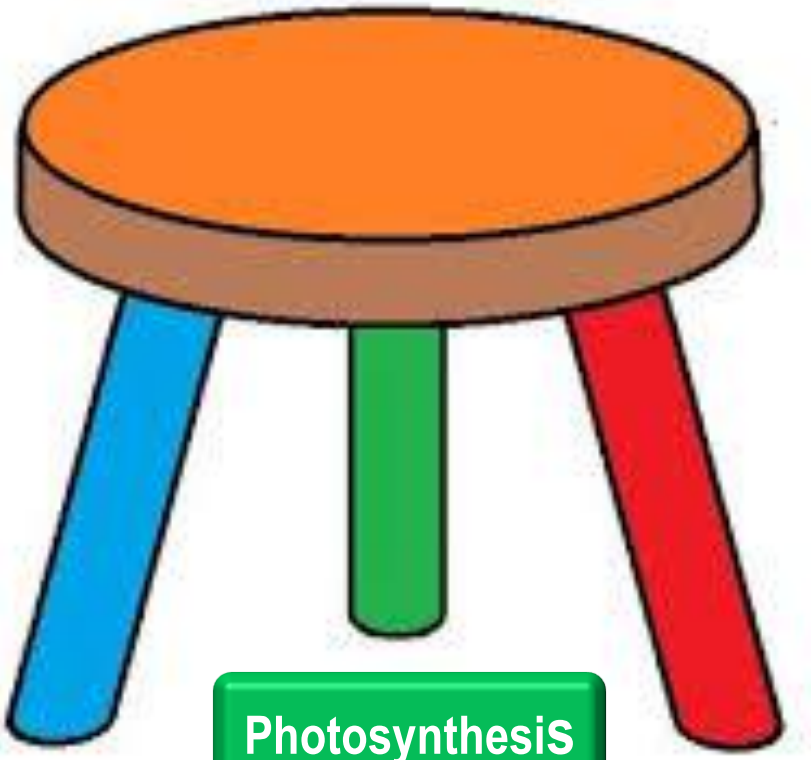
— Paul Freet, serial entrepreneur



GROWER SKILL

“Technology is only as good as its TALENT.”

GROWER SKILL

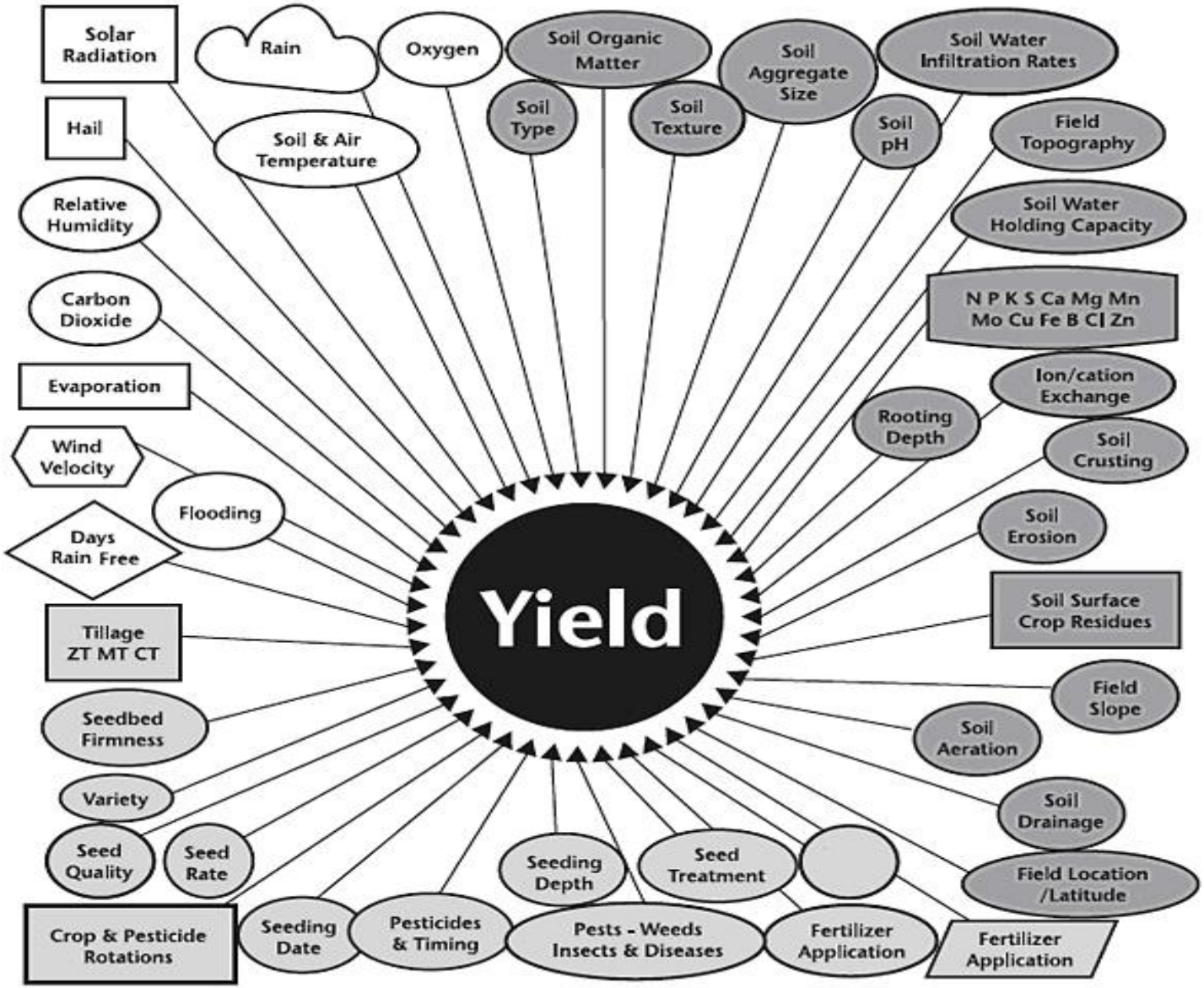


PhotosynthesiS

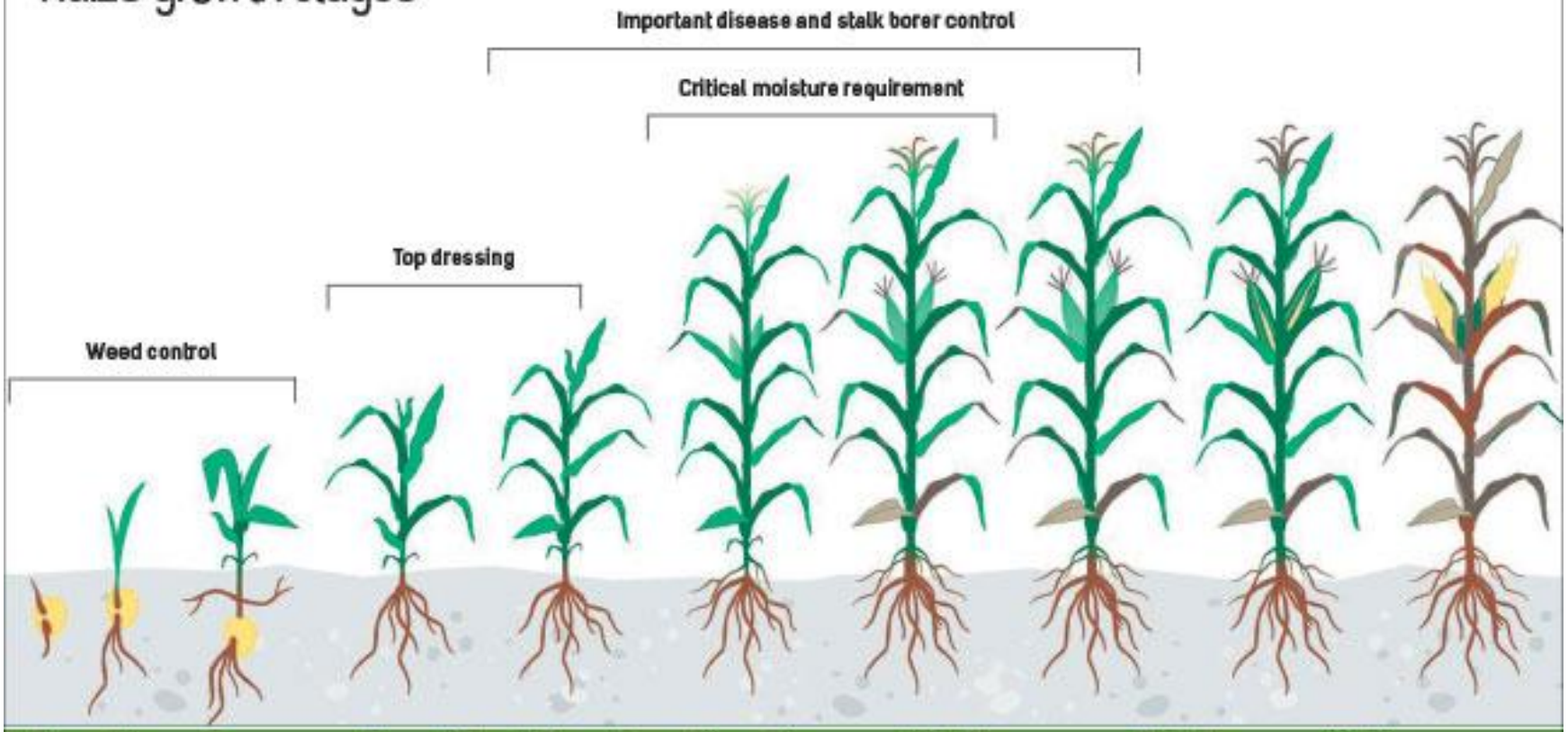
Respiration

Transpiration

PRODUCTIVITY
IN FIELD GROWING

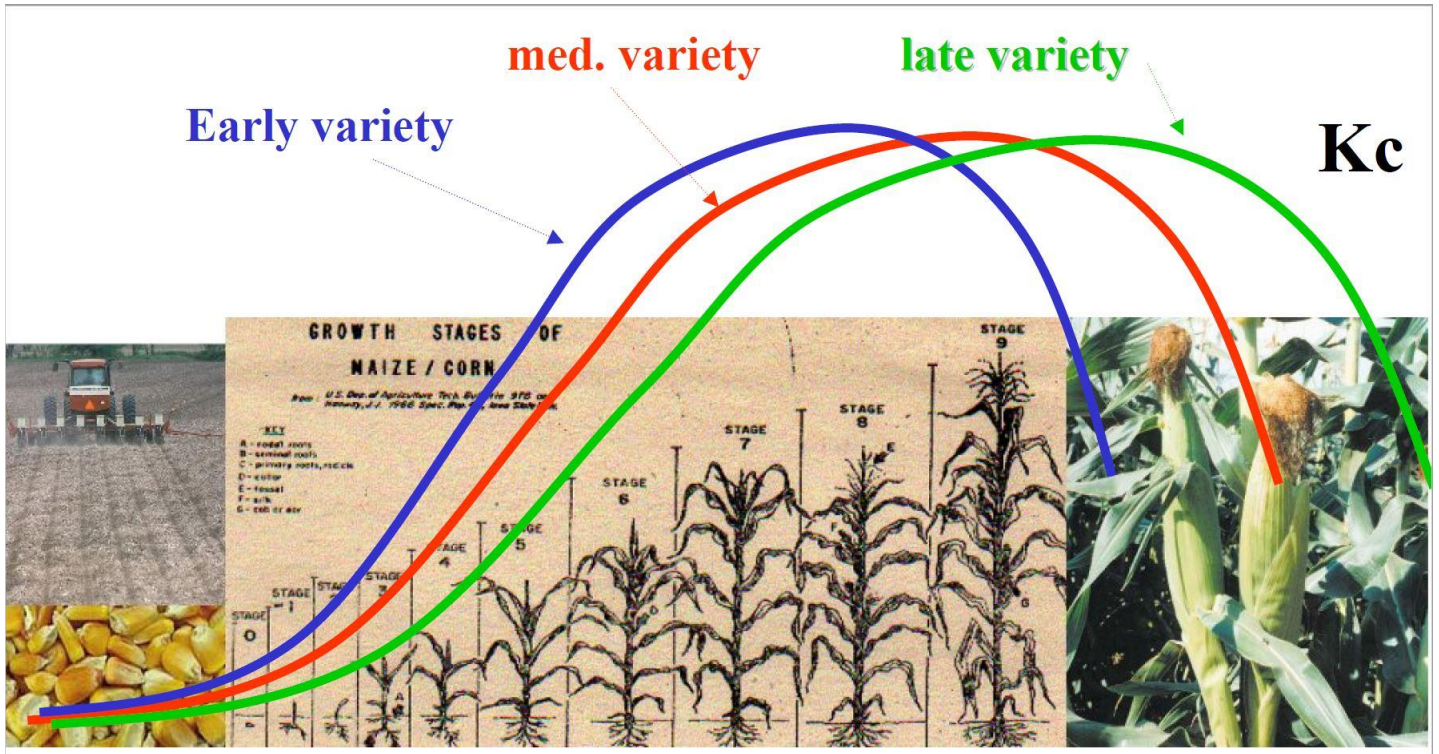

Yield
Solar Radiation
Rain
Oxygen
Soil Organic Matter
Soil Aggregate Size
Soil Water Infiltration Rates
Hail
Soil & Air Temperature
Soil Type
Soil Texture
Soil pH
Field Topography
Relative Humidity
Soil Water Holding Capacity
Carbon Dioxide
N P K S Ca Mg Mn Mo Cu Fe B Cl Zn
Evaporation
Ion/cation Exchange
Rooting Depth
Soil Crusting
Wind Velocity
Flooding
Soil Erosion
Days Rain Free
Soil Surface Crop Residues
Tillage ZT MT CT
Field Slope
Seedbed Firmness
Soil Aeration
Variety
Soil Drainage
Seed Quality
Seed Rate
Seeding Depth
Seed Treatment
Field Location /Latitude
Crop & Pesticide Rotations
Seeding Date
Pesticides & Timing
Pests - Weeds Insects & Diseases
Fertilizer Application
Fertilizer Application

Maize growth stages

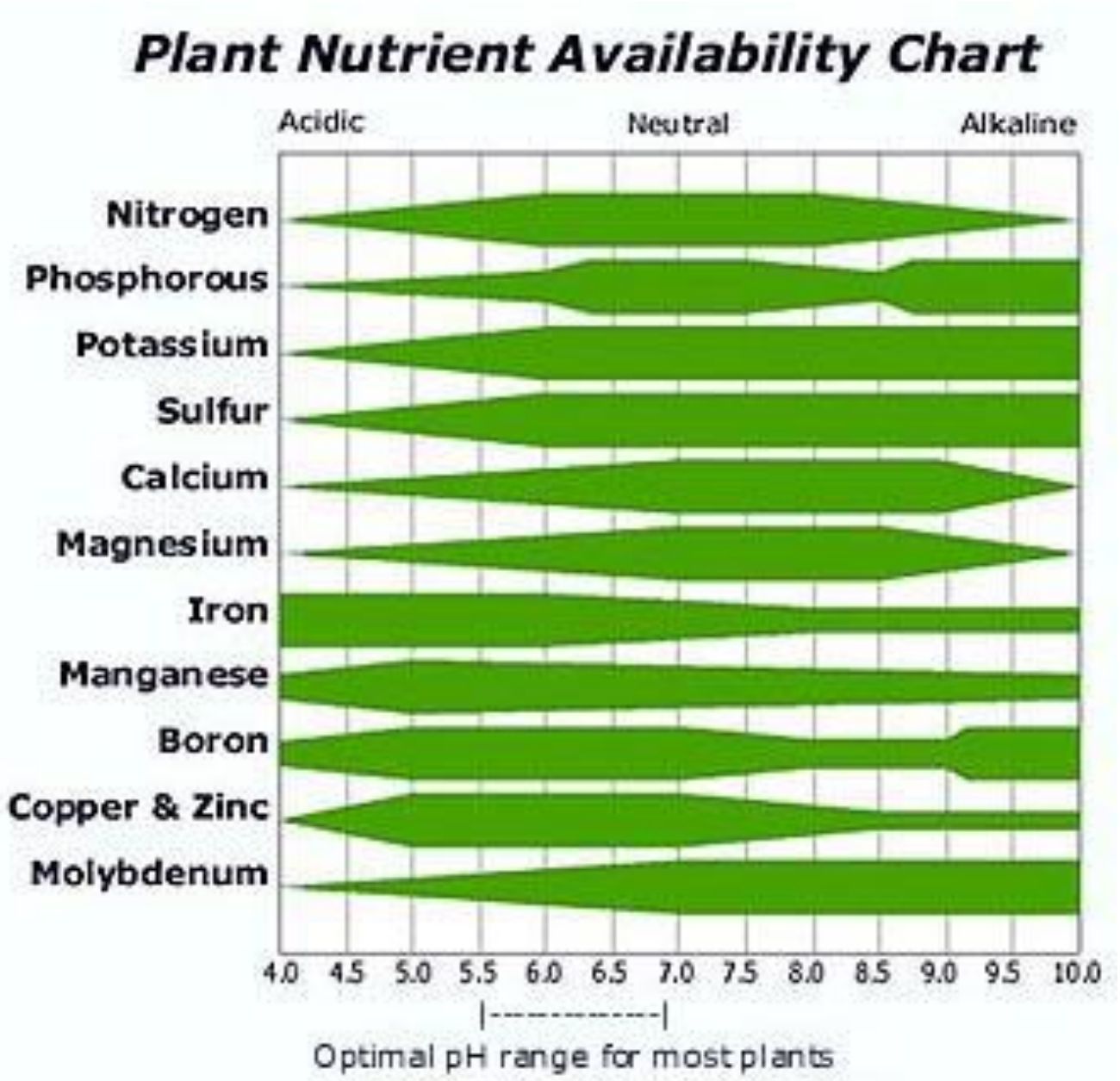


V0	V2	V5	V8	V10	V12	V14	VT	R1	R2 to R3	R3 to R4	R5 to R6
Days after emergence *											
0	7	21	32	38	44	49	56	63	70 77 84	91 98 105	112 119 160
Germination and emergence. Planting depth 5cm – 8cm	Plant population established. Growth point 20mm – 25mm below surface. Five-leaf: cob and tassel initiation		Cob development		Active growth: leaves and cob development, grace root development. 12-leaf: cob size determined		Pollination: five to 10 days		Kernel development	Grain filling; nutrients transported to cob	Physiological maturity – end of mass gain	Ready for harvest – 14% moisture
Vegetative growth stages									Reproductive development stages		

* The number of days varies between growth classes and environments.



3- to adapt the variety (early –med.- late)

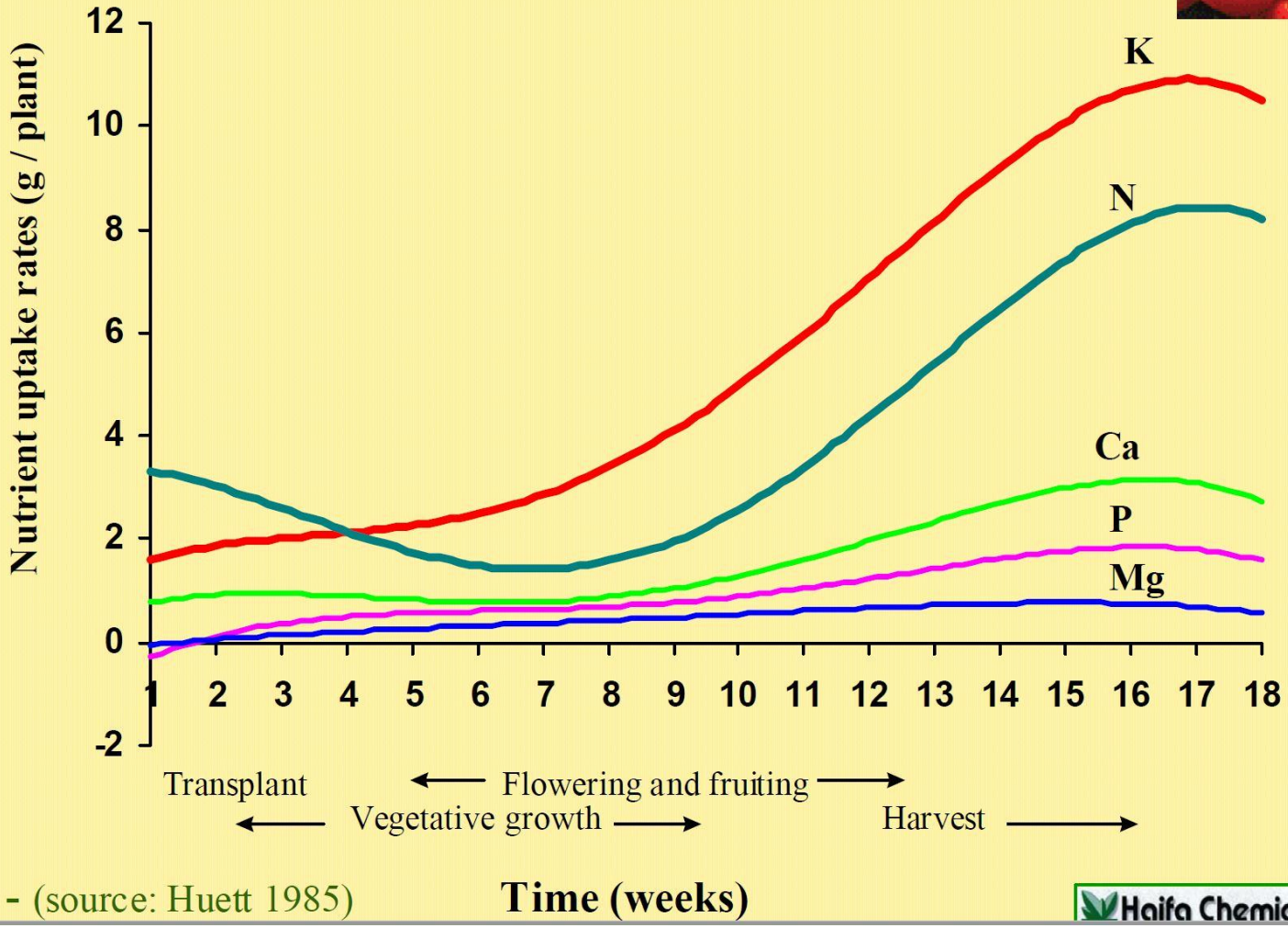

Plant Nutrient Availability Chart
Acidic
Neutral
Alkaline
Nitrogen
Phosphorous
Potassium
Sulfur
Calcium
Magnesium
Iron
Manganese
Boron
Copper & Zinc
Molybdenum
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0
|----------|
Optimal pH range for most plants

AVERAGE Nutrient Content [Nitrogen (N), Phosphate (P_2O_5) And Potassium (K_2O)] for Selected Organic Materials

Product	N	P_2O_5	K_2O
	Dry Weight Basis		
Fish meal	10	6	0
Bone meal	3	22	0
	Dried Commercial Manure Products		
Chicken	1.5	1.5	2
Cattle	2	3	3
Pigs	2	2	1

- These composition values are approximates ONLY because ranges in nutrient concentration exist for any organic material.
- The mineralization (decay) rate will vary with material.
- Materials with high N or P concentrations and rapid decay rates should be used carefully because of greater potential for pollution if nutrients are leached.

Nutrient Uptake Rates for Tomatoes *



* - (source: Huett 1985)

Haifa Chemicals Ltd

OPTIMUM NITROGEN

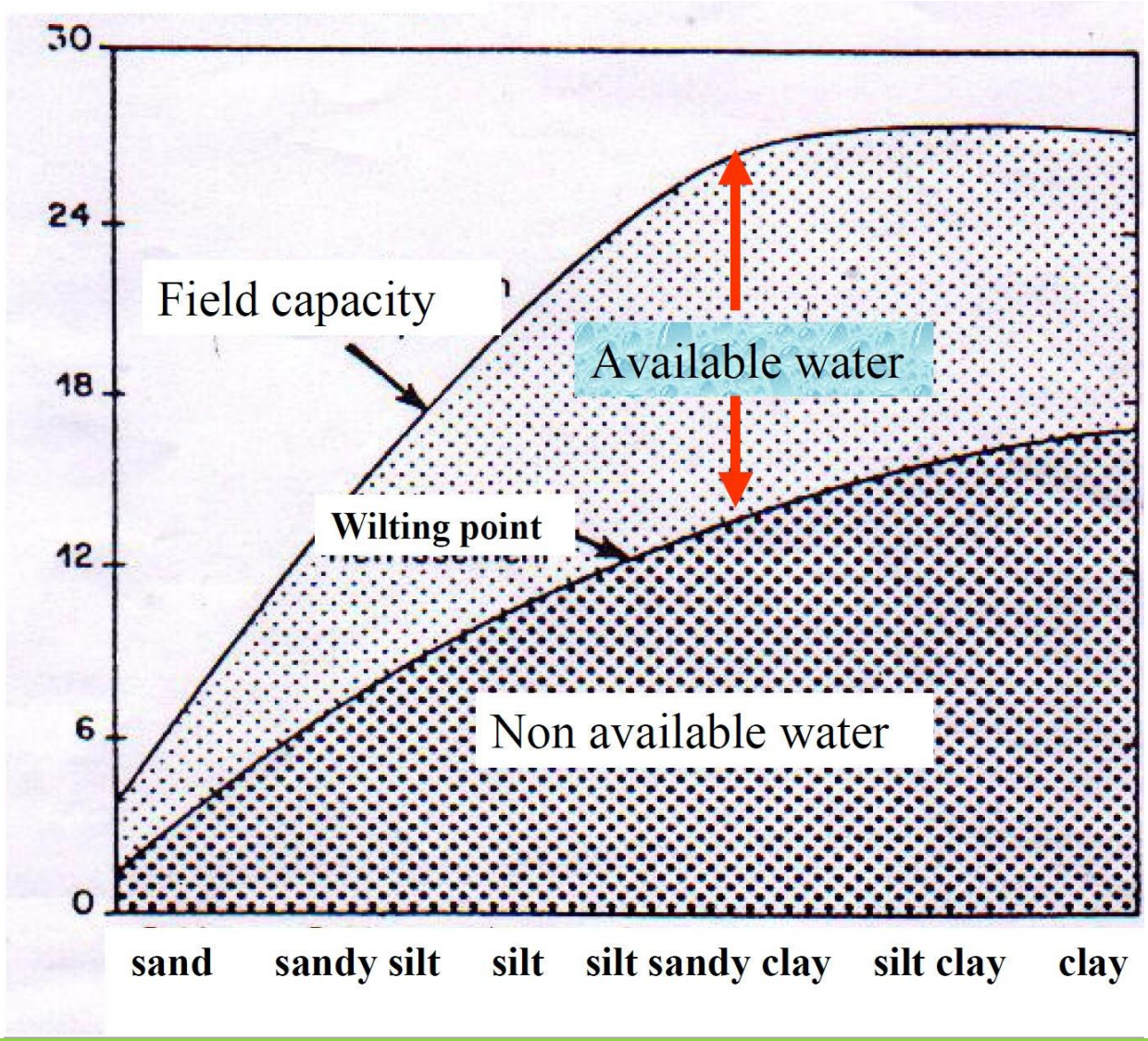
Reduces GHG Emissions

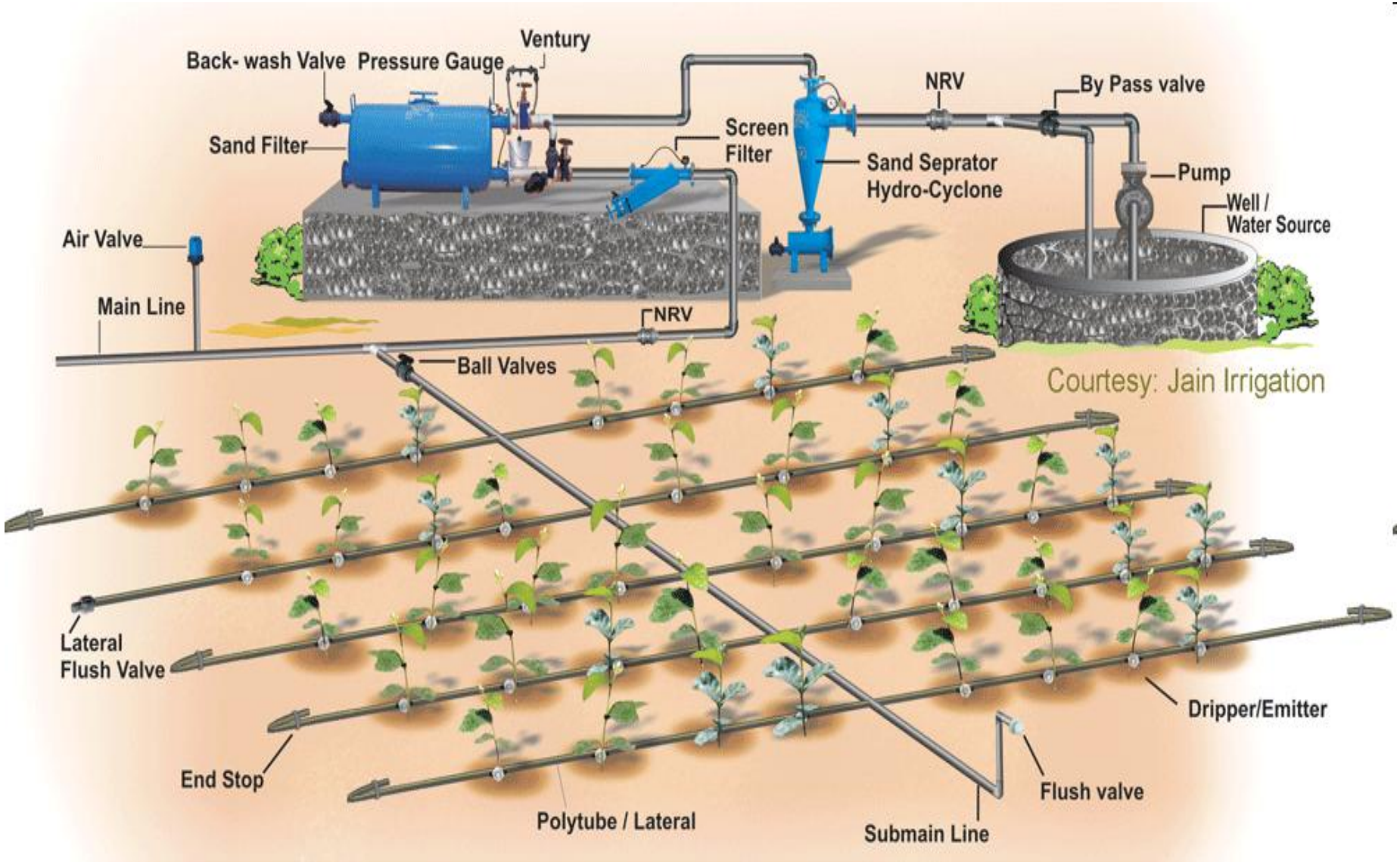
1. Using the correct amount
2. Applying using proper schedule & method of placement

EXCESS NITROGEN

- Leads to reduced profits when it does not contribute to greater yields or improved fruit quality.
- Recent research with vegetables & strawberries shows reduced yields & reduced fruit quality with excess N.
- Excess N can lead to more disease, and for tomato, to more damage from insects such as thrips.

% Water in Soil



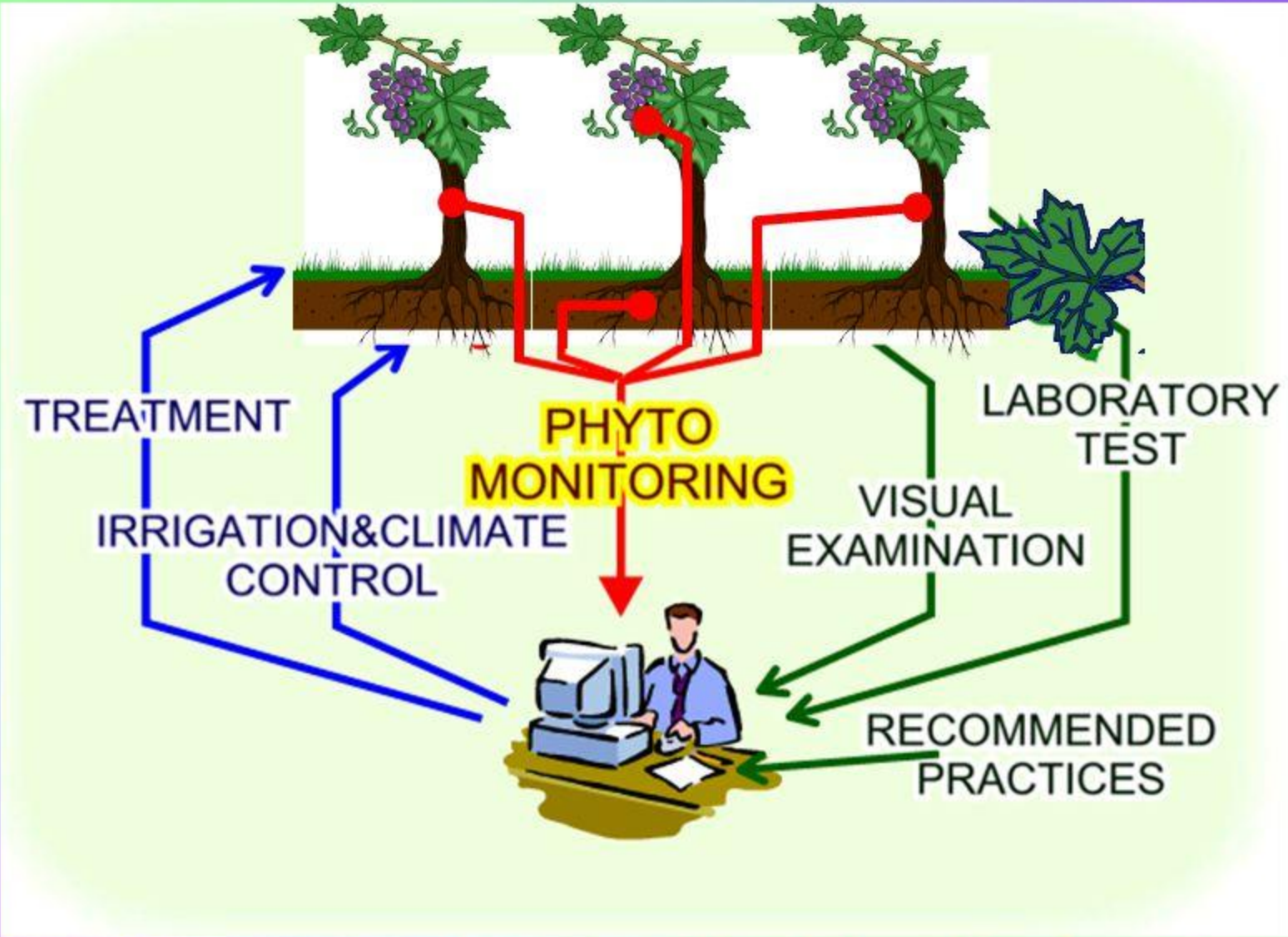

Ventury
Back- wash Valve
Pressure Gauge
NRV
By Pass valve
Sand Filter
Screen Filter
Sand Seprator Hydro-Cyclone
Pump
Well / Water Source
Air Valve
Main Line
NRV
Ball Valves
Courtesy: Jain Irrigation
Lateral Flush Valve
Dripper/Emitter
End Stop
Polytube / Lateral
Flush valve
Submain Line

WATER REQUIREMENTS

Optimal Growth:

1 inch / acre / week = 28,314 gallons

PHYTOMONITORING™ in CROP GROWTH CONTROL



Phytomonitoring is the operational information channel
based on direct measurement of plant water state and growth

Mechanization & Farm Hands:

1 hand = 26 acres vs 1 hand = 2 acres

InVessel Compost

Seedling Production

Row Mulcher

Base Fertilizer

Bed Shaping

Mulch Laying

Transplanting

Row Covers

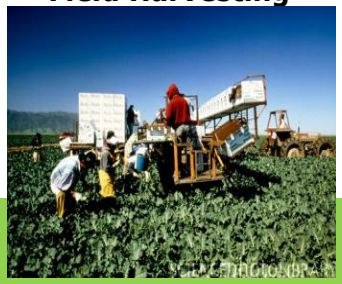
Scouting

Pesticide Application

Mechanical Weeding

Pollination

Field Harvesting



Mechanical Harvesting

Bed Mowing

Mulch Retrieval

PRODUCTIVITY
IN PROTECTED STRUCTURES

GROWING IN SOIL

POSITIVES

- Low cost

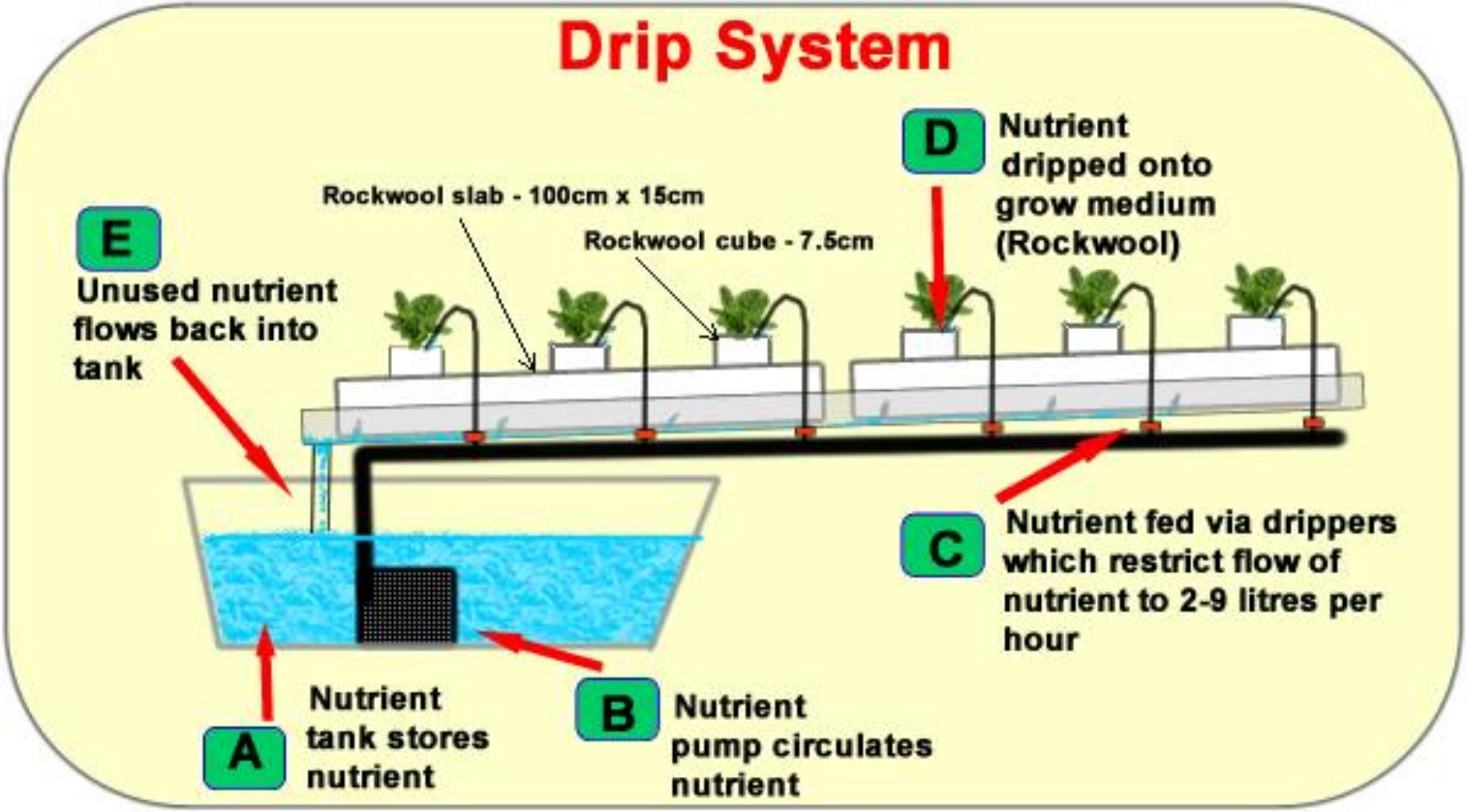
NEGATIVES

- Rainfall helps to leach harmful salts out of the soil
- With no rainfall, harmful salts can build up in the soil causing toxicity

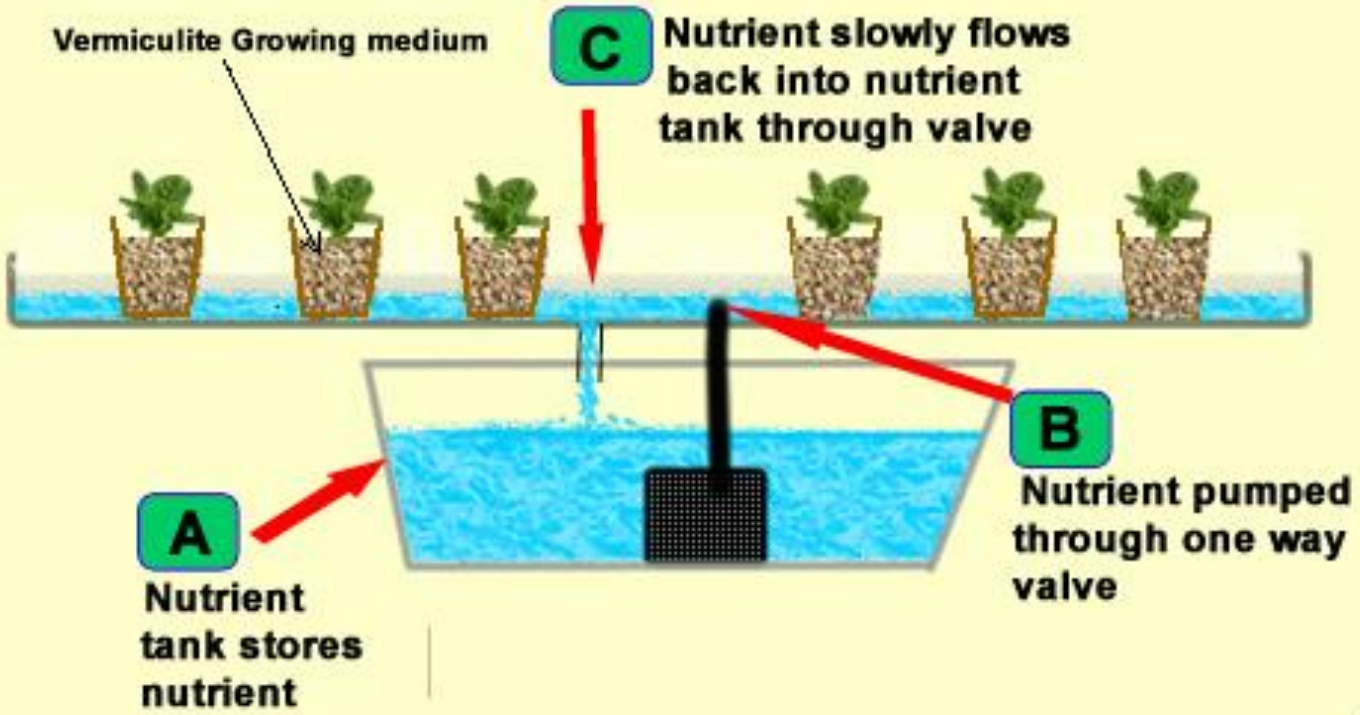
GROWING IN WATER

Hello Hydroponics!

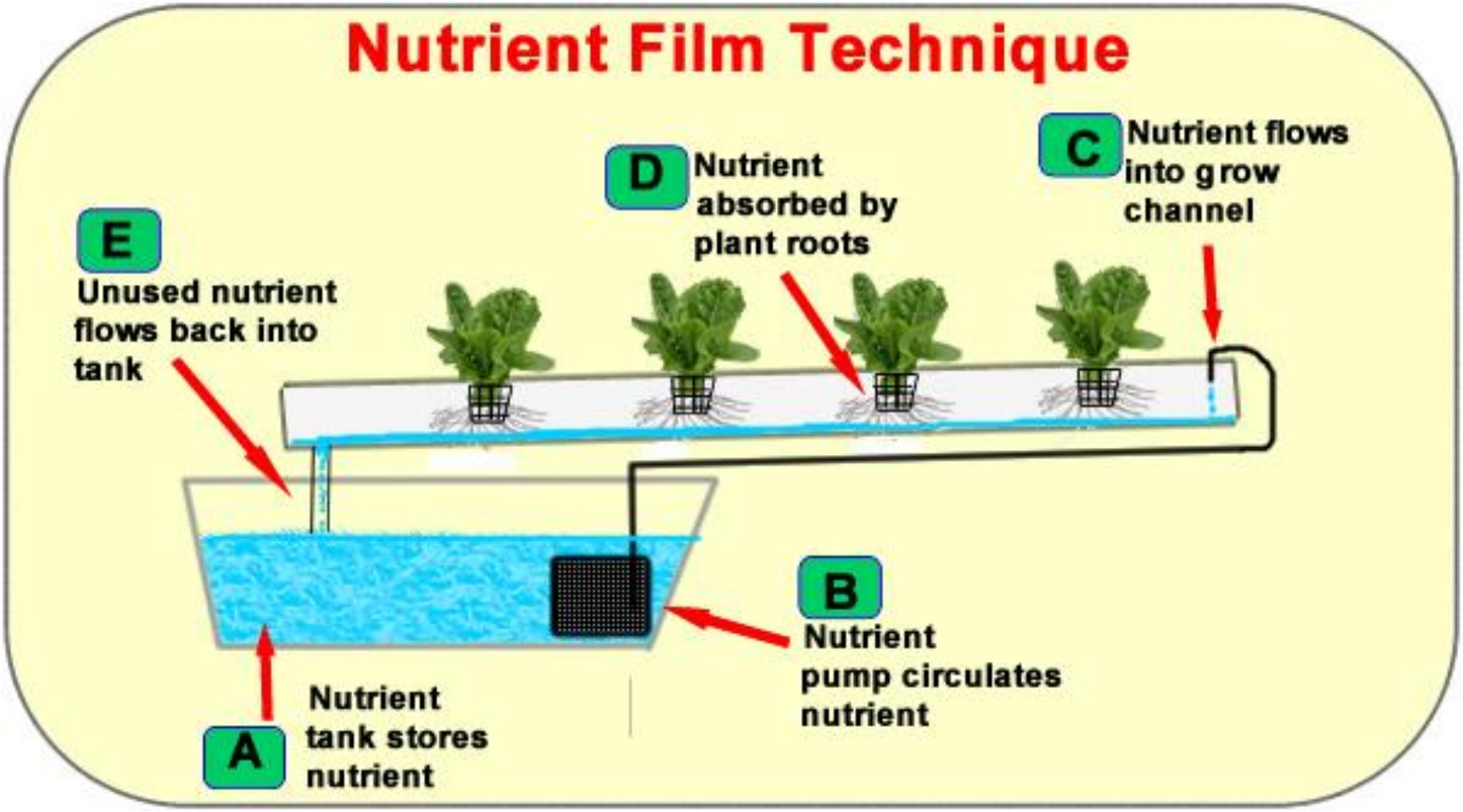
Drip System


D
Nutrient dripped onto grow medium (Rockwool)
Rockwool slab - 100cm x 15cm
Rockwool cube - 7.5cm
E
Unused nutrient flows back into tank
C
Nutrient fed via drippers which restrict flow of nutrient to 2-9 litres per hour
A
Nutrient tank stores nutrient
B
Nutrient pump circulates nutrient

Flood and Drain



Nutrient Film Technique



HORIZONTAL vs VERTICAL

60% more plants in horizontal vs vertical

GROWTH RATE FACTORS

- High light intensity = faster growth
- High temp = increased photosynthesis, respiration
- High humidity = decreased transpiration, increased pathogens (diseases)
- Low air flow = decreased transpiration, photosynthesis

A rapidly growing crop under good growing conditions is going to need more nutrients over the same period of time than one under slow growing conditions.

PROTECTED IPM

Integrated Pest Management

Agro-technical: sanitation

Physical: Insect-proof screenings, sticky traps, UV absorbing films

Chemical: selective pesticides (IGRs, botanicals)

Biological: resistant strains, biological controls

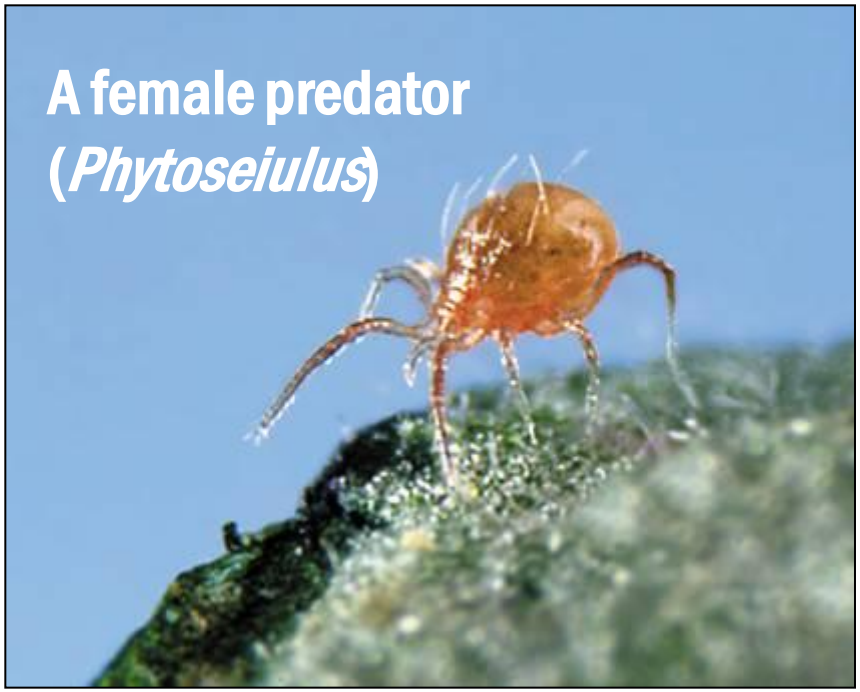
Western flower thrips - adult female

Pest

Commercial package

Two-spotted spidermite - adult, nymphs and egg

A female predator (*Phytoseiulus*)



Predator in action

Results of predation

Commercial package

Build up of Na^+, Cl^-, K^+, Ca^{2+} over time in water will require water to be changed (dumped)

Inorganic Fertilizers

- Good growers = every 6-8 weeks
- Poor growers = every 2-4 weeks

Commercial organic fertilizers: >6 months

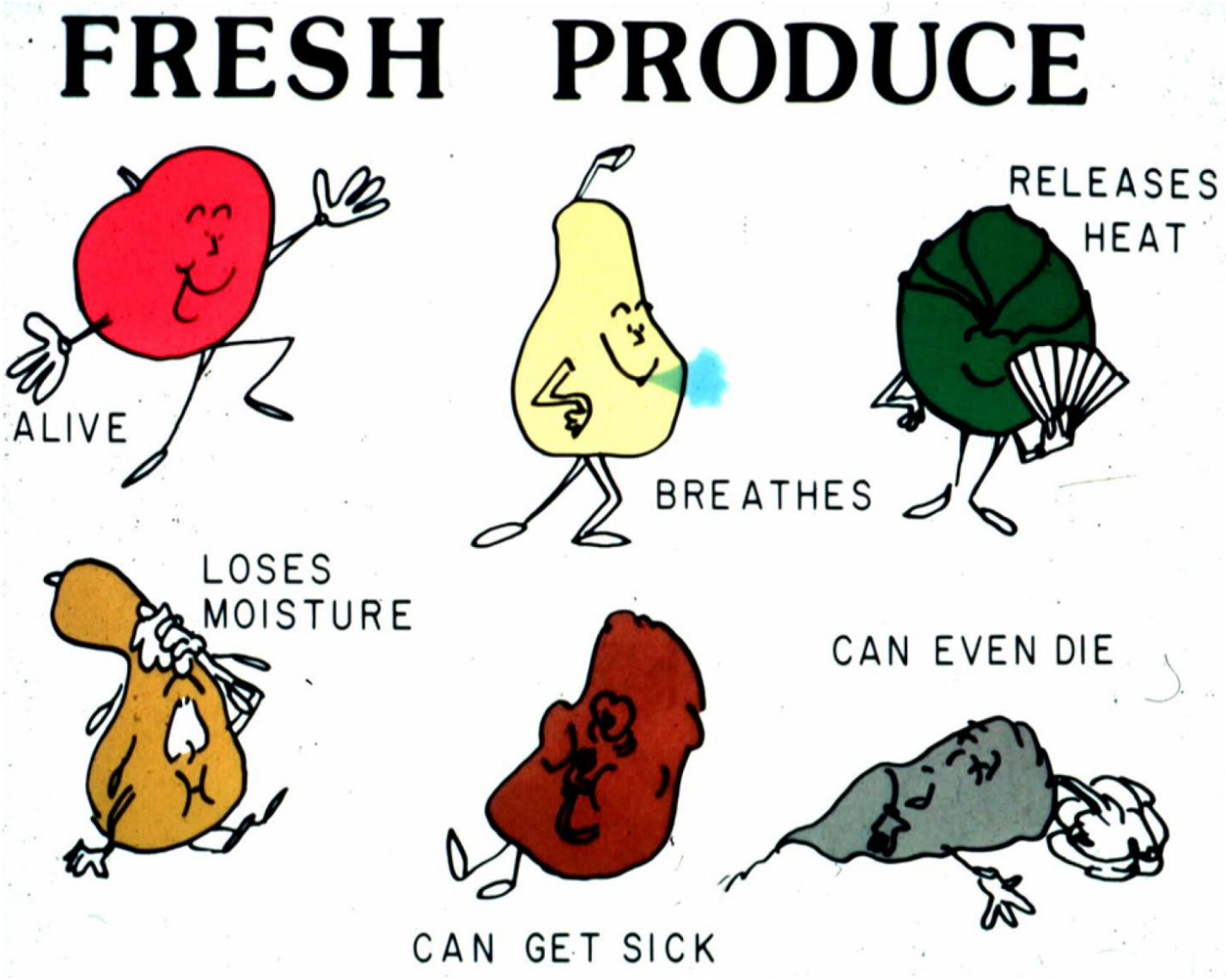
NFT EFFICIENCY

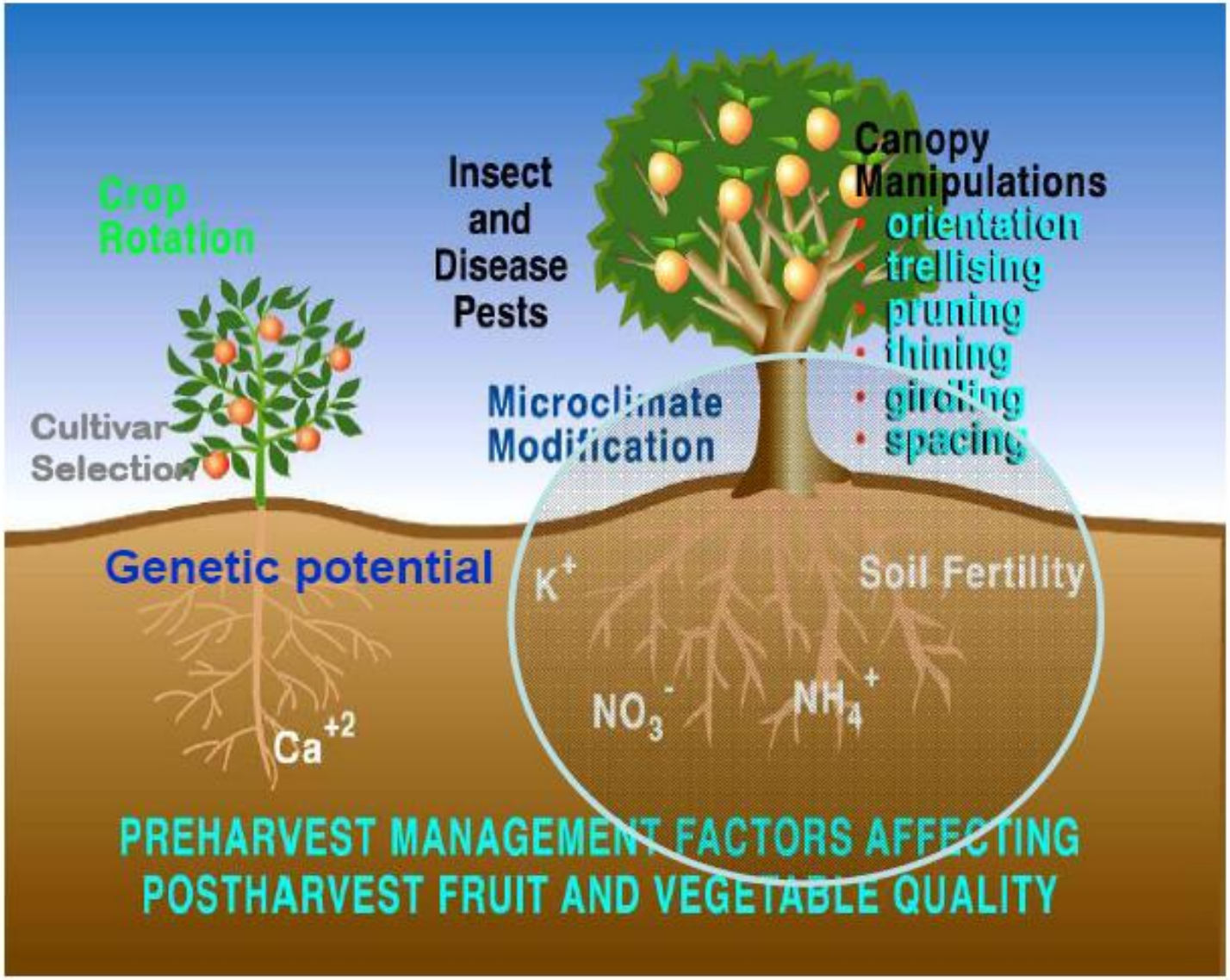
- Removes 50% factors impacting yield
- Uses 10% water of soil-based farms
- Uses 20% fertilizer of soil-based farms

- 1.5X more plants per m^2
- 2.5X more crops per year

PRODUCTIVITY
IN POST HARVEST MANAGEMENT

FRESH PRODUCE




Crop Rotation
Insect and Disease Pests
Canopy Manipulations
orientation
trellising
pruning
thining
girdling
spacing
Microclimate Modification
Cultivar Selection
Genetic potential
K+
Soil Fertility
NO3-
NH4+
Ca+2
PREHARVEST MANAGEMENT FACTORS AFFECTING
POSTHARVEST FRUIT AND VEGETABLE QUALITY

POSTHARVEST LOSSES

Harvesting = severing the umbilical cord

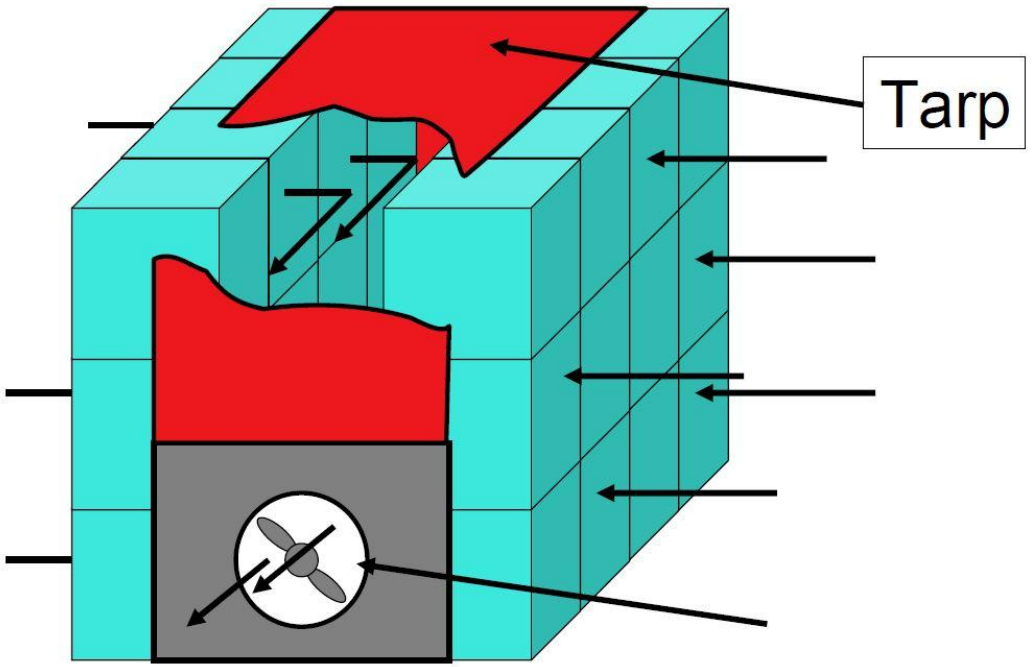
Postharvest losses = 50%-80% in developing nations

Rules of Thumb:

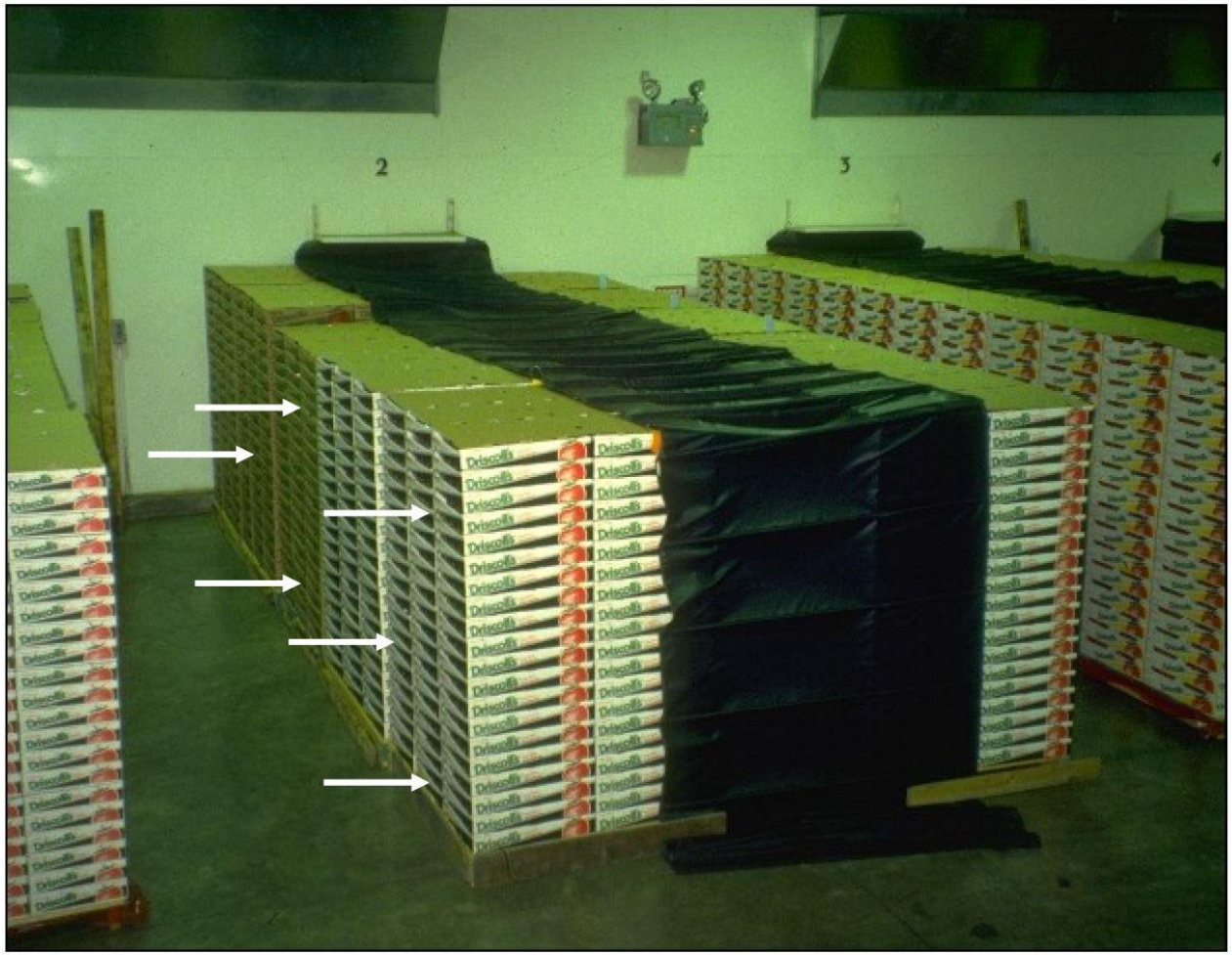
- For every hour field heat is not removed from produce, we lose 1 day of shelf life
- For every 10°C increase in temperature, rate of decay increases 2X – 3X
- Cool produce down to ⅞ cool time for optimum shelf life

FORCED AIR COOLING

Forced Air - Tunnel



FORCED AIR COOLING



COOLBOT


CoolBot
36
Room Fins Heater Program
Room
Fins
Heater
Power


Build your own walk in cooler w/
a coolbot & an air conditioner

Reduce Electricity Use in Cold Storage and Forced-Air Coolers

- Maximize use of refrigerated volume.
- Install efficient lighting.
- Improve refrigeration system efficiency.
- Minimize exterior heat gain.
- Minimize fan electricity use.


Thank
You